MFC

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Project Overview

MFC (Multi-Component Flow Code) simulates compressible multi-component, multiphase flows, which encompasses physics and numerics problems.

Shedding Water Droplet Example

Our focus for this internship was mostly on the code side, so we didn't do much in terms of the physics, or numeric.

Goals and Milestones (Brian)

- Make multiple successful pull request
- Have a good understanding of how to contribute to open source projects
- Make some optimization to the code
- First PR Merged - Reached 05/26/24
- 10 PRs - Reached 06/25/24
- Fix 3 Major Issues - Almost Reached

Goals and Milestones (Cameron)

- Improve user-friendliness/quality of life
- Support and analyze performance of novel hardware (GH200)

Highlights and Accomplishments (Brian)

- Much of my focus for this Internship was on CI (Continuous Integration) specifically with Github Actions.
- Added Code Coverage with CodeCov
  - What is Code Coverage?
  - Why is it needed?

- Added Pathy to CI
  - Pathy is a path filter extension to detect changes in a Github Action Workflow
  - Mostly used as a first step for many of the heavier tests

- Add Examples to CI (WIP)
  - 61 Examples now getting tested
  - Debugged 10+ broken Examples
  - Especially important for new users, and Longevity
  - WIP because doesn't work with all features, will continue to debug it

- Added Intent/Formatted Entire Fortran Source
  - Added Intent/Formatted 40 Files
  - What is Intent?

- I have plans to continue working on MFC, and I hope to make some optimization to the code.

Highlights and Accomplishments (Cameron)

- Improve reporting of malformed case parameters.
  - When given an input with a parameter of the wrong type, MFC would point to a valid parameter as the cause!
  - In addition to highlighting the invalid parameter, I improved the diagnostic messages MFC presents.

- Add GH200 Unified Memory Support
  - The GH200 is capable of sharing memory between CPU and GPU.
  - Configured build system to support
  - Profile using NSight Systems to determine maximum practical input
  - No longer crashes on 80GB input, performance stays consistent until 160GB input, only lose performance at 160GB input
  - Cause: constant pagefaults
  - Overall – doubled the viable input size for a given node, allowing for less communication between nodes!

Open Source Outcomes

(Brian)
- The biggest thing I learned is that contributing to Open Source Projects are less intimidating then I thought.

(Cameron)
- Fixing smaller problems to existing projects is a great way to inspire deeper investigation into the problem the project aims to solve!

Future Work

- Fix double-compilation with unified memory
- Refactor Riemann Solvers
- Squash remaining bugs for CI Example

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